System Wide Information Management (SWIM)

Instructional Example of
How to Write a
Web Service Requirements Document (WSRD)

Version 2

July 15, 2013

Replaces Version 1 dated September 27, 2012

Foreword

The Web Service Requirements Document (WSRD) contained herein is an instructional example of a set of requirements developed as prescribed by FAA-STD-070 [4] for a fictitious "Flight Plan Service (FPS)".

The FAA Pilot/Controller Glossary (P/CG) defines a flight plan as "specified information relating to the intended flight of an aircraft that is filed orally or in writing with an FSS or an ATC facility." This example WSRD simulates a scenario in which a new Web service is needed for filing and modifying a flight plan on-line.

This document does not attempt to model or suggest a new Web service. Therefore, while an effort was made to present realistic requirements for a Web service that could be developed for flight planning, a number of logical and technical components that a "real" Web service usually requires were purposely omitted to make it easier for a reader to perceive or understand the major notions presented in FAA-STD-070. For the same reason, all technological standards or protocols employed in this example should not be taken as endorsing, recommending, or favoring any technology used in implementing Web services.

To make this example complete, the WSRD also includes a fictitious "Flight Plan Exchange Model" (FPXM) designed to enable the management and distribution of flight plan data in digital format (see more in section 5.2.4 of this document). This model and associated artifacts, including a fictitious flight plan schema and diagram, do not represent any actual model or artifacts developed or being developed by FAA and should not be used for any purpose except as an instructional aide.

It should be mentioned that there is also an associated instructional example of how to write a Web Service Description Document (WSDD) that describes a fictitious implemented FPS in accordance with FAA-STD-065A, *Preparation of Web Service Description Documents* [3].

Questions about the example WSRD may be directed to:

Federal Aviation Administration
Communication, Information and Network Programs, Enterprise Engineering, AJM-31
800 Independence Avenue, SW
Washington, DC 20591

Typographical Conventions used in the Instructional Example

Page headers, page numbers, figure and table captions, etc. are in accordance with FAA-STD-070 Section 4, General Requirements [4].

FAA-STD-070 does not dictate other stylistic aspects of a WSRD (e.g., font face, font size, page borders, etc.).

Instances of shaded and bordered paragraphs (like this) inserted at several points in this document represent **explanatory notes** that would not appear in an actual WSRD.

U.S. Department
of Transportation
Federal Aviation
Administration

Web Service Requirements Document
Flight Plan Service (FPS)

Web Service Requirements Document
Flight Plan Service (FPS)

Approval Signatures

Name	Organization	Signature	Date Signed
John Smith	FAA En Route Services Modernization Group, ANG-X		July 17, 2012
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Betty Brown	Alpha Airlines		August 9, 2012

Revision Record

Revision Letter	Description	Revision Date	Entered By
A	Editorial changes to bring document into compliance with FAA-STD-070.	July 13, 2012	Jane Doe

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1 Scope

This Web Service Requirements Document (WSRD) provides the requirements for the Flight Plan Service (FPS). This service will give a service consumer the capability to file, modify, and cancel a flight plan operating under Instrument Flight Rules (IFR).

This WSRD has been prepared in accordance with FAA-STD-070, Department of Transportation Federal Aviation Administration, Preparation of Web Service Requirements Documents [4].

1.1 Background

In today's NAS environment, a flight plan specifies information that describes a desired route of flight between a well-defined departure and destination point within which separation services are required. Additional information provided in the flight plan shows that the flight meets the legal requirements of Instrument Flight Rules (IFR).

The intended outcome of filing an IFR flight plan is to receive air traffic control (ATC) separation services between the departure and destination airports through a subsequent flight plan clearance.

As a part of transitioning toward the Next Generation Air Transportation System (NextGen), the En Route Services Modernization Group (ESMG) intends to implement this flight plan filing capability as a Web-enabled service.

2 Applicable Documents

NOTE: Documents [5] and [6] are fictitious.

2.1 Government Documents

[1]   FAA Acquisition System Toolset (FAST) Test and Evaluation Process Guidelines, January 2011, http://fast.faa.gov/docs/teguidelines.doc

[2]   FAA Order 1370.92A, Password and PIN Management Policy, 6 August 2010, http://www.faa.gov/documentLibrary/media/Order/1370.92A.pdf

[3]   FAA-STD-065A, Web Service Description Documents, FAA, 1 July 2013, http://www.tc.faa.gov/its/worldpac/standards/faa-std-065A.pdf

[4]   FAA-STD-070, Preparation of Web Service Requirements Documents, FAA, 12 July 2012, http://www.tc.faa.gov/its/worldpac/standards/faa-std-070.pdf

[5]   Flight Plan Exchange Model (FPXM) Version 1.0, FAA, 10 January 2006, http://faa.gov/fpxm/2006/

[6]   Flight Plan Service Final Requirements Document (ESMG-123), FAA, January 2010 (Available on request from En Route Services Modernization Group)

[7]   NIST FIPS Publication 200, Minimum Security Requirements for Federal Information and Information Systems, March 2006, http://csrc.nist.gov/publications/fips/fips200/FIPS-200-final-march.pdf

[8]   NIST Special Publication 800-95, Guide to Secure Web Services, National Institute of Standards and Technology, August 2007, http://csrc.nist.gov/publications/nistpubs/800-95/SP800-95.pdf

2.2 Non-Government Standards and Other Publications

[9]   ANSI/INCITS 359-2004, American National Standard for Information Technology - Role Based Access Control, Information Technology Industry Council, 3 February 2004, http://www.cs.purdue.edu/homes/ninghui/readings/AccessControl/ANSI+INCITS+359-2004.pdf

[10]   Extensible Markup Language (XML) 1.0 (Fifth Edition), W3C Recommendation 26 November 2008, http://www.w3.org/TR/2008/REC-xml-20081126/

[11]   RFC 2119, Key words for Use in RFCs to Indicate Requirement Levels, Network Working Group, March 1997, http://www.rfc-editor.org/rfc/rfc2119.txt

[12] RFC 2616, Hypertext Transport Protocol – HTTP/1.1, Network Working Group, June 1999, http://www.w3.org/Protocols/rfc2616/rfc2616.html

[13] RFC 5246, The Transport Layer Security (TLS) Protocol Version 1.2, Network Working Group, August 2008, http://tools.ietf.org/html/rfc5246

[14] SOAP Version 1.2 Part 1: Messaging Framework (Second Edition), W3C Recommendation, 27 April 2007, http://www.w3.org/TR/soap12-part1/

[15] Web Services Description Language (WSDL) Version 2.0 Part 1: Core Language, W3C Recommendation 26 June 2007, http://www.w3.org/TR/wsdl20

[16] Web Services Security, UsernameToken Profile 1.0, OASIS Standard 200401, March 2004, http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0.pdf

[17] Web Services Security: SOAP Message Security 1.1 (WS-Security 2004), OASIS Standard Specification, 1 February 2006, http://www.oasis-open.org/committees/download.php/16790/wss-v1.1-spec-os-SOAPMessageSecurity.pdf

[18] XML Signature Syntax and Processing (Second Edition), W3C Recommendation, 10 June 2008, http://www.w3.org/TR/xmldsig-core

3 Definitions

3.1 Terms and Definitions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [11]. These key words are capitalized when used to unambiguously specify requirements. When these words are not capitalized, they are meant in their natural-language sense.

Terms and definitions shown below are taken from FAA-STD-070 [4] unless otherwise indicated.

Access Control	Protection of system resources against unauthorized access; a process by which use of system resources is regulated according to a security policy and is permitted by only authorized entities.
Audit	A process that records information needed to establish accountability for system events and for the actions of system entities that cause them.
Audit Trail	A chronological record of system activities that is sufficient to enable the reconstruction and examination of the sequence of environments and activities.
Authentication	The process of verifying an identity claimed by or for a system entity.
Authorization	The granting of rights or permission to a system entity (mainly but not always a user or a group of users) to access a Web service.
Binding	An association between an interface, a concrete protocol, and a data format. A binding specifies the protocol and data format to be used in transmitting messages defined by the associated interface.
Business Function	A characteristic action or activity that needs to be performed to achieve a desired objective, or in the context of this WSRD, to achieve a real world effect.
Confidentiality	Protective measures that assure that information is not made available or disclosed to unauthorized individuals, entities, or processes (i.e., to any unauthorized system entity).

Credentials	Data that is transferred to establish the claimed identity of an entity.
Data Element	A unit of data for which the definition, identification, representation, and permissible values are specified by means of a set of attributes.
Datatype	A computer representation of a well-known abstract concept such as *integer* or *date*.
Effect	A state or condition that results from interaction with a service. Multiple states may result depending on the extent to which the interaction completes successfully or generates a fault.
FAA Data Registry (FDR)	A Web-enabled system (http://fdr.gov/fdr/Home.jsp) that provides ready access to the agency's data description standards and is compliant with the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) Standard 11179, Information Technology – Metadata Registries (MDR), Parts 1 – 6 (http://metadata-standards.org/11179/).
FAA Telecommunications Infrastructure (FTI)	A network that supports National Airspace System (NAS) operations by providing the connectivity required by systems including the Enhanced Traffic Management Systems (ETMS), the Standard Terminal Automated Replacement System (STARS), and the Wide Area Augmentation System (WAAS), and applications like e-mail, Internet, payroll, and other administrative services. (Adapted from http://www.faa.gov/air_traffic/technology/fti/)
Fault	A message that is returned as a result of an error that prevents a service from implementing a required function. A fault usually contains information about the cause of the error.
Format	The arrangement of bits or characters within a group, such as a data element, message, or language.
Idempotent	A term used to describe an operation in which a given message will have the same effect whether it is received once or multiple times; i.e., receiving duplicates of a given message will not cause any undesirable effect.

Identifier (ID)	A sequence of characters, capable of uniquely identifying that with which it is associated, within a specified context.
Input	Data entered into, or the process of entering data into, an information processing system or any of its parts for storage or processing.
Integrity	Protective measures that assure that data has not been changed, destroyed, or lost in an unauthorized or accidental manner.
Interface	See Service Interface.
Internet	A large, heterogeneous collection of interconnected systems that can be used for communications of many different types between any interested parties connected to it. The term includes both the "core Internet" (Internet service provider networks) and "edge Internet" (corporate and private networks, often connected via firewalls, network address translation boxes, application layer gateways, and similar devices).
Message	An identifiable collection of units of information (data elements), presented in a manner suitable for communication, interpretation, or processing within a context of interacting SOA components.
Message Exchange Pattern (MEP)	A template, devoid of application semantics, that describes a generic pattern for the exchange of messages between agents. It describes the relationships (e.g., temporal, causal, sequential, etc.) of multiple messages exchanged in conformance with the pattern, as well as the normal and abnormal termination of any message exchange conforming to the pattern.
Metadata	Data that defines or describes other data.
Name	The designation of an object by a linguistic expression.
Namespace	A collection of names, identified by a URI reference, that are used in XML documents as element types and attribute names. The use of XML namespaces to uniquely identify metadata terms allows those terms to be unambiguously used across applications, promoting the possibility of shared semantics.

Non-Repudiation	Protective measures against false denial of involvement in a communication.
Operation	A set of messages related to a single Web service action.
Output	Data transferred out of, or the process by which an information processing system or any of its parts transfers data out of, that system or part.
Permissible Values	The set of allowable instances of a data element.
Precondition	A state or condition that is required to be true before an action can be successfully invoked.
Processing	A set of algorithms, calculations, or business rules that operate on input data in order to produce the required output or to produce a change of internal state.
Protocol	A formal set of conventions governing the format and control of interaction among communicating functional units.
Quality of Service (QoS) Characteristic	A parameter that specifies and measures the value of a provided service.
Real World Effect	An ultimate purpose associated with the interaction with a particular service. It may be the response to a request for information or the change in the state of some entities shared between the participants in the interaction.
Role	A collection of permissions to use resources made available by a Web service.
Role-Based Access Control (RBAC)	A form of identity-based access control where the system entities that are identified and controlled are functional positions in an organization or process.
Security	The protection of information and data so that unauthorized persons or systems cannot read or modify them and authorized persons or systems are not denied access to them.
Service	See Web service.
Service Category	One or more values selected from a hierarchical convention that is used to categorize all FAA services.

Service Consumer	An organization that seeks to satisfy a particular need through the use of capabilities offered by means of a service.
Service Criticality	A single value selected from a list of values that is used to categorize a service in terms of the significance given to a functional failure of that service.
Service Description	The information needed in order to use, or consider using, a service.
Service Interface	An abstract boundary that a Web service exposes. It defines the types of messages and the message exchange patterns that are involved in interacting with the Web service, together with any conditions implied by those messages.
Service Provider	An organization that offers the use of capabilities by means of a service.
Software Agent	A running program that drives Web services, both to implement them and to access them.
Synchronous Operation	A type of operation whose message exchange pattern describes temporally coupled or "lock-step" interactions, e.g., remote procedure call (RPC)-style request-response interactions.
Token	A data object or a portable, user-controlled, physical device used to verify an identity in an authentication process.
User	A human, his/her agent, a surrogate, or an entity that interacts with information processing systems. A person, organization entity, or automated process that accesses a system, whether authorized to do so or not.
Web Service	A platform-independent, loosely-coupled software component designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format. Other systems interact with the Web service in a manner prescribed by its description by means of XML-based messages conveyed using Internet transport protocols in conjunction with other Web-related standards.

3.2 Acronyms and Abbreviations

ANSI	American National Standards Institute
ATC	Air Traffic Control
ATS	Air Traffic Services
ESMG	FAA En Route Services Modernization Group
FAA	Federal Aviation Administration
FDR	FAA Data Registry
FIPS	Federal Information Processing Standards
FPS	Flight Plan Service
FPXM	Flight Plan Exchange Model
FSS	Flight Service Station
FTI	FAA Telecommunications Infrastructure
hPa	hectopascal
HTTP	Hypertext Transport Protocol
ICAO	International Civil Aviation Organization
ID	Identifier
IEC	International Electrotechnical Commission
IFR	Instrument Flight Rules
INCITS	InterNational Committee for Information Technology Standards
ISO	International Organization for Standardization
MDR	Metadata Registry
MEP	Message Exchange Pattern
MSL	Mean Sea Level
NAS	National Airspace System
NextGen	Next Generation Air Transportation System
NIST	National Institute of Standards and Technology
OASIS	Organization for the Advancement of Structured Information Standards

P/CG	Pilot/Controller Glossary
PIN	Personal Identification Number
QoS	Quality of Service
RBAC	Role-Based Access Control
RFC	Request For Comments
RPC	Remote Procedure Call
SOA	Service-Oriented Architecture
SOAP	Simple Object Access Protocol
TLS	Transport Layer Security
TMP	Traffic Modernization Program
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
W3C	World Wide Web Consortium
WSDD	Web Service Description Document
WSDL	Web Services Description Language
WSRD	Web Service Requirements Document
WSS	Web Service Security
XML	eXtensible Mark-up Language

4 Required Service Information

NOTE: This section must not contain any requirements.

4.1 Service Characteristics

Name: Flight Plan Service (FPS)

Description: Service for filing, deleting, and modifying an IFR flight plan for subsequent automatic submission to FAA flight data processing

Namespace: urn:us:gov:dot:faa:example:atm:enroute:fps

Revision: A

Service Category: Air Traffic Control Information Service [urn:us:gov:dot:faa:taxonomies:service-category#1.3.1.3]

Flight Information Service [urn:us:gov:dot:faa:taxonomies:service-category#1.3.1.3.2]

Criticality Level: Essential [urn:us:gov:dot:faa:taxonomies:service-criticality#essential]

4.2 Service Provider

Name: FAA En Route Services Modernization Group (ESMG)

Description: A program within the FAA Air Traffic Organization responsible for developing Web services

Namespace: urn:us:gov:dot:faa:example:atm

Web Page: http://www.faa.gov/air_traffic/flight_info/

4.3 Service Consumers

4.3.1 Traffic Modernization Program (TMP)

Name: FAA Traffic Modernization Program (TMP)

Description: The FAA-maintained program responsible for regulating traffic during arrival, departure, or approach stages of flights with the goal to avoid exceeding airport or air traffic control capacity.

Web Page: http://www.faa.gov/air_traffic/TMP/ *

4.3.2 Alpha Airline

Name: Alpha Airline

Description: A United States commercial air carrier headquartered in Atlanta, Georgia. Alpha Airline provides air transport services for passengers and freight.

Web Page: http://www.example.alpha.com *

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* The URLs in section 4.3 are provided as examples only and do not resolve to any resource.

5 Functional Requirements

5.1 Service Business Function Requirements

1. The FPS SHALL allow consumers to file a flight plan as described in section 3.1.1 of the FPS Final Requirements Document [6].

2. The FPS SHALL allow consumers to change the destination aerodrome of a filed flight plan as described in section 3.1.2 of the FPS Final Requirements Document [6].

3. The FPS SHALL allow consumers to retract (i.e., cancel) a filed flight plan as described in section 3.1.3 of the FPS Final Requirements Document [6].

Table 5-1 addresses the above business function requirements in terms of real world effects as prescribed by FAA-STD-070 [4].

Table 5-1 FPS Business Functions

Business Function	Real World Effect
File a flight plan.	A flight plan has been filed and persists in the FAA Web server for distribution to the FAA flight data processing application within some parameter time of the estimated departure time.
Change destination aerodrome of a flight plan.	The destination aerodrome of a filed flight plan has been changed.
Cancel a flight plan.	A previously filed flight plan has been retracted before being submitted to FAA ATS, thereby reducing the flight plan processing load and systemic workload of the FAA air traffic planning system.

5.2 Service Interface Requirements

1. The FPS SHALL implement a single interface called "FlightPlanInterface" which includes three (3) operations described in Table 5-2.

Table 5-2 FPS Interface Specification

Name	Description	Operations
FlightPlanInterface	FlightPlanInterface allows a service consumer to file and subsequently modify or cancel a flight plan.	FileFlightPlan UpdateDestinationAerodrome CancelFlightPlan

5.2.1 Operations

1. The FPS SHALL perform operation FileFlightPlan as specified in section 5.2.1.1 below.

2. The FPS SHALL perform operation UpdateDestinationAerodrome as specified in section 5.2.1.2 below.

3. The FPS SHALL perform operation CancelFlightPlan as specified in section 5.2.1.3 below.

Messages to be exchanged during execution of the operations are specified in section 5.2.2 of the WSRD. Faults to be generated as a result of operation failure are specified in section 5.2.3 of the WSRD.

5.2.1.1 Operation FileFlightPlan
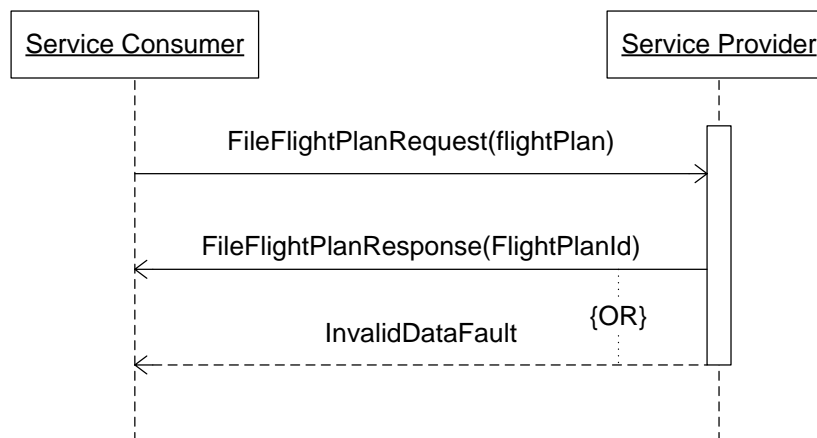
Figure 5-1 Operation FileFlightPlan Sequence Diagram

Table 5-3 Operation FileFlightPlan Specification

Name	FileFlightPlan
Description	The FileFlightPlan operation allows the creation of persistent information defining an intended flight (flight plan).
Message Exchange Pattern	In-Out [urn:us:gov:dot:faa:taxonomies:messageExchangePattern#in-out]
Operation Type	Synchronous
Idempotency	Idempotent
Precondition	Service consumer has been authenticated and authorized to perform the FileFlightPlan operation.
Input	Message FileFlightPlanRequest containing required flight plan information encapsulated in FlightPlan element.
Output	Message FileFlightPlanResponse containing FlightPlanId for filed flight plan.
Effect	Flight plan has been submitted (filed).
Faults	Fault InvalidDataFault is returned when submitted flight plan data is not valid and service is unable to process the flight plan.

5.2.1.2 Operation UpdateDestinationAerodrome
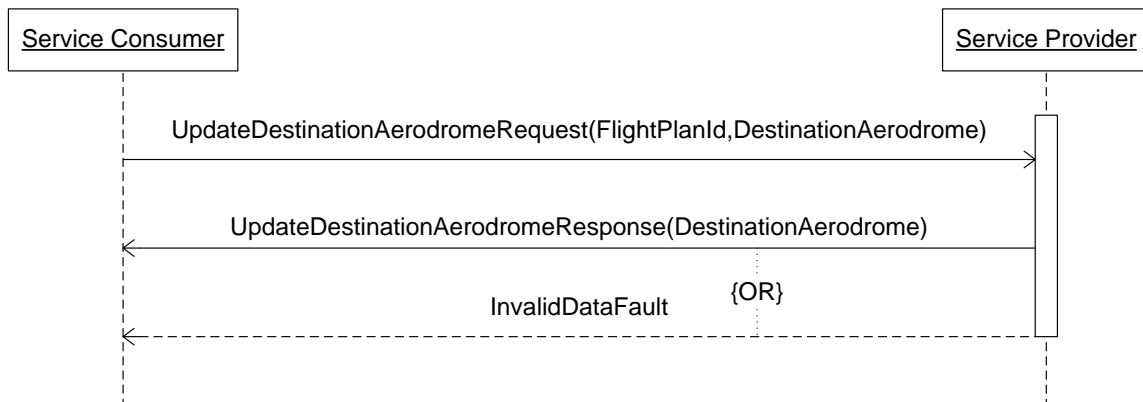
Figure 5-2 Operation UpdateDestinationAerodrome Sequence Diagram

Table 5-4 Operation UpdateDestinationAerodrome Specirfication

Name	UpdateDestinationAerodrome
Description	The UpdateDestinationAerodrome operation allows updating the destination aerodrome information within a filed flight plan.
Message Exchange Pattern	In-Out [urn:us:gov:dot:faa:taxonomies:messageExchangePattern#in-out]
Operation Type	Synchronous
Idempotency	Idempotent
Precondition	Service consumer has been authenticated and authorized to update flight plan information. The referenced flight plan has been filed.
Input	Message UpdateDestinationAerodromeRequest containing FlightPlanId and the new destination aerodrome.
Output	Message UpdateDestinationAerodromeResponse containing Flight Plan ID of the updated flight plan (FlightPlanId) and Aerodrome data for the destination aerodrome as it is recognized by the service.
Effect	Originally indicated flight destination aerodrome has been changed.
Faults	Fault InvalidDataFault is returned when submitted flight plan ID or aerodrome ID is not valid.

5.2.1.3 Operation CancelFlightPlan
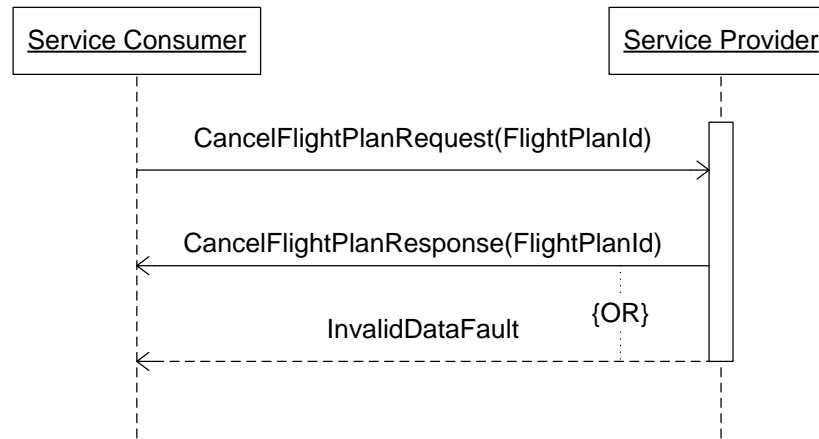
Figure 5-3 Operation CancelFlightPlan Sequence Diagram

Table 5-5 Operation CancelFlightPlan Specification

Name	CancelFlightPlan
Description	The CancelFlightPlan operation allows canceling a previously filed flight plan.
Message Exchange Pattern	In-Out [urn:us:gov:dot:faa:taxonomies:messageExchangePattern#in-out]
Operation Type	Synchronous
Idempotency	Idempotent
Precondition	Service consumer has been authenticated and authorized to perform the CancelFlightPlan operation. The referenced flight plan has been filed.
Input	Message CancelFlightPlanRequest containing FlightPlanId of a FlightPlan to be canceled.
Output	Message CancelFlightPlanResponse containing confirmation of canceling the flight plan.
Effect	Flight plan has been canceled.
Faults	Fault InvalidDataFault is returned when submitted flight plan ID is not valid

5.2.2 Messages

1. The FPS SHALL exchange with <u>service consumers</u> the <u>messages</u> listed and specified in Table 5-6.

Table 5-6 FPS Message Specification

Name	Description	Direction	Data Objects/Elements
FileFlightPlanRequest	Used by a service consumer to submit (file) a flight plan.	In	<u>FlightPlan</u>
FileFlightPlanResponse	Used to inform a service consumer that flight plan information has been accepted and returns the <u>ID</u> that has been assigned to the flight plan.	Out	<u>FlightPlanId</u>
UpdateDestinationAerodromeRequest	Used by a service consumer to change a destination aerodrome.	In	<u>DestinationAerodrome</u>, <u>FlightPlanId</u>
UpdateDestinationAerodromeResponse	Used to inform a service consumer that the original destination aerodrome has been changed.	Out	<u>DestinationAerodrome</u>, <u>FlightPlanId</u>
CancelFlightPlanRequest	Used by a service consumer to cancel a previously filed flight plan.	In	<u>FlightPlanId</u>
CancelFlightPlanResponse	Used to inform a service consumer that the flight plan has been canceled.	Out	<u>FlightPlanId</u>

5.2.3 Faults

1. If the value of a flight plan <u>element</u> is invalid or missing from the <u>consumer</u> request and no default value was established, then the FPS SHALL respond with an InvalidDataFault <u>fault</u> <u>message</u> as described in Table 5-7.

NOTE: A <u>service</u> will ordinarily have more than one fault message.

Table 5-7 FPS Fault Message Specification

Name	Description	Data Objects/Elements
InvalidDataFault	Used to inform a service consumer that submitted flight plan data is not valid and FPS is unable to process the flight plan.	<u>InvalidDataError</u>

5.2.4 Data Elements

NOTE: Section 5.9.2.4 requirement (s) of FAA-STD-070 [4] states that a data model of all data used by the service shall be included in this section of the WSRD. A data model is usually the result of an architectural effort, and a reference to the model's location in the architecture can be made instead of reproducing the model in the WSRD.

In this WSRD example, we have simulated a scenario in which a "Flight Plan Exchange Model" has been developed as a separate effort and the FPS is being required by the WSRD to conform to this model. Because the example is unable to supply a real URL for the model, a conceptual model of the data elements that appear in the FlightPlan XML schema is provided in Figure 5-4, and the XML schema itself is provided in Appendix A (a diagram of the schema is in Appendix B.) An example of an instantiation of this schema is shown in Appendix C.

1. All data exchanged by the FPS SHALL conform to the FPXM 1.0, Flight Plan Exchange Model, 10 January 2006, available at http://faa.gov/fpxm/2006/ * [5]. A conceptual data model (Figure 5-4) is available at http://faa.gov/fpxm/2006/FPXM_Conceptual Model.pdf *.

2. All data elements provided by the FPS SHALL be valid, that is, conform to definitions, syntax, and constraints as defined in the XML schema found at http://faa.gov/fpxm/2006/fpxm10.xsd *. (See Appendix A for a copy of the schema.) Data elements are also specified in Table 5-8 in accordance with FAA-STD-070 section 5.9.2.4 [4].

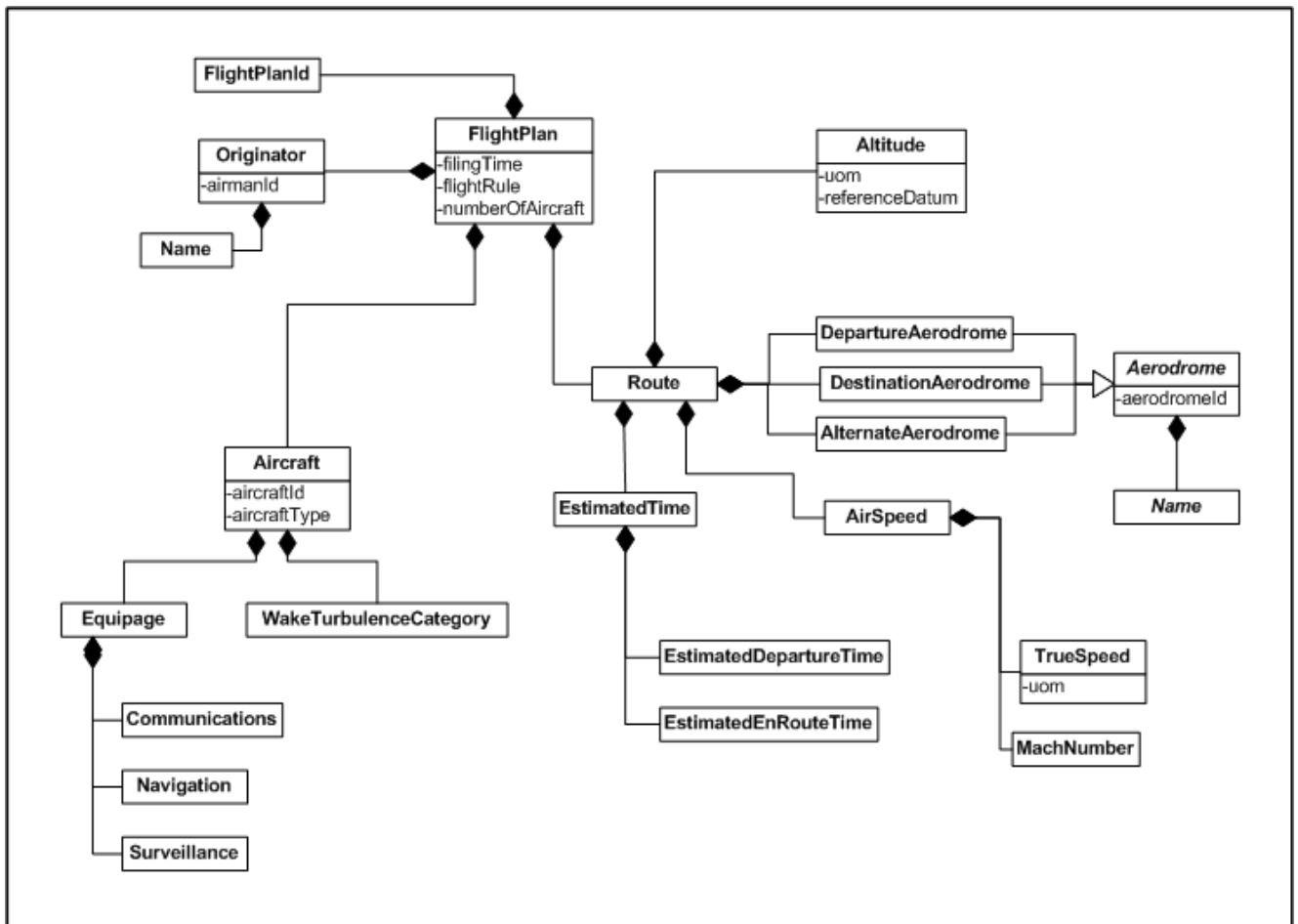* The URLs in section 5.2.4 are provided as examples only and do not resolve to any resource.

Figure 5-4 Flight Plan Exchange Conceptual Model

NOTE: Section 5.9.2.4 requirement (a) of FAA-STD-070 [4] states that section 5.2.4 of the WSRD shall list and specify all data elements, of complex or primitive datatype, that appear in messages (or faults) to be sent or received via the Web service. The following table does not contain an exhaustive list of all of the data elements but rather provides a subset of elements selected to exemplify how data elements should be presented in a WSRD.

Note also that all metadata is required (Unit of Measure and Permissible Values are required if applicable) except for Maximum Length and Format which are optional. In addition, two of the elements have been registered in the FAA Data Registry (FDR) and given registration identifiers.

All data elements in Table 5-8 are defined in the namespace urn:us:gov:dot:faa:example:atm:enroute:fps:entities

Table 5-8 Selected Flight Plan Data Elements

FDR ID	Name	Definition	Permissible Values	Unit of Measure	Datatype	Format	Obligation	Occur-rence
	FlightPlan	The outmost container (root) element for all data provided by the pilot or his/her designated representative to air traffic services units, relative to the intended flight or portion of the flight of the aircraft.	N/A	N/A	Complex		Required	1
	FlightPlanId	An element that uniquely identifies the flight plan.	N/A	N/A	String	[A-Za-z0-9]*	Required	1
	FlightPlan.flightRule	A code representing regulations (i.e., instrument or visual flight rules) under which the pilot is flying or intends to fly the aircraft.	"I" – IFR only "V" – VFR only "Y" – IFR first "Z" – VFR first	N/A	String		Required	1

FDR ID	Name	Definition	Permissible Values	Unit of Measure	Datatype	Format	Obligation	Occur-rence
	FlightPlan.filingTime	The point in time (UTC) at which the flight plan is filed.	N/A	N/A	dateTime	CCYY-MM-DDThh:mm:ssZ	Required	1
	Altitude	An element that indicates the pressure altitude above mean sea level (MSL) at which the aircraft is flying or is intended to be flown.	N/A	N/A	Complex		Required	1
	Altitude.uom	A code representing the units of measure of the aircraft's altitude.	"m", "meter" – altitude in meters "foot" – altitude in feet	N/A	String		Required	1
	Altitude.referenceDatum	A code representing the atmospheric pressure reference used to adjust a pressure altimeter.	"Local" – local pressure extrapolated to zero MSL. "Standard" – pressure with respect to the pressure datum 1013.2 hectopascals (hPa).	N/A	String		Required	1
	Aircraft	A container element for all data related to the aircraft.	N/A	N/A	Complex		Required	1
2730	Aircraft.aircraftType	An aircraft type designator that informs an air traffic controller of the performance characteristics of the aircraft.	Values are listed in ICAO 8643, Aircraft Type Designators, http://legacy.icao.int/anb/ais/8643/.	N/A	String		Required	1

FDR ID	Name	Definition	Permissible Values	Unit of Measure	Datatype	Format	Obligation	Occur-rence
2732	WakeTurbulenceCategory	A code that classifies the aircraft for the purpose of wake turbulence separation minima, based on the maximum certified takeoff mass of the aircraft.	"H", "HEAVY" – aircraft having a maximum certificated take-off mass of 136,000 kg (300,000 lb) or more. "M", "MEDIUM" – aircraft having a maximum certificated take-off mass of less than 136,000 kg (300,000 lb) and more than 7,000 kg (15,500 lb). "L", "LIGHT" – aircraft having a maximum certificated take-off mass of 7,000 kg (15,500 lb) or less.	N/A	String		Required	1
	DestinationAerodrome	A container element for all data related to the primary aerodrome to which the flight is destined.	N/A	N/A	Complex		Required	1

FDR ID	Name	Definition	Permissible Values	Unit of Measure	Datatype	Format	Obligation	Occur-rence
	DestinationAerodrome. aerodromeId	An element that uniquely identifies the destination aerodrome.	Values are listed in ICAO Document 7910, Location Indicators, http://store1.icao.int/mainpage.ch2.	N/A	String	[A-Z][A-Z][A-Z][A-Z]	Required	1
	DestinationAerodrome. Name	An element that contains the name or location (nearest city) of the destination aerodrome.	N/A	N/A	String		Optional	1

All data elements in Table 5-9 are defined in the namespace urn:us:gov:dot:faa:example:atm:enroute:fps:entities

Table 5-9 Selected Flight Plan Service Elements

FD R ID	Name	Definition	Unit of Measure	Permissible Values	Datatype	Obligation	Occurrence
	InvalidDataError	A field that contains the faulty value.	N/A	One or more (separated by a comma and a space) of the following values: "Flight Rule", "Number Of Aircraft", "Filing Time", "Flight Plan Id", "Airman Id", "Originator Name", "Aircraft Type", "Aircraft Id", "Equipage Communication", "Equipage Navigation", "Equipage Surveillance", "Wake Turbulence Category", "Altitude Reference Datum", "Altitude Unit of Measure", "Estimated Departure Time", "Estimated Enroute Time", "True Speed Unit of Measure", "True Speed", "Mach Number", "Departure Aerodrome Id", "Destination Aerodrome Id", "Alternate Aerodrome Id"	String	Required	1

5.3 Machine-Processable Service Description Document

1. The FPS SHALL present an externalized machine-processable service description document, hereinafter called "WSDL file", which defines and describes its interface and invocation bindings.

2. The WSDL file SHALL comply with the Web Services Description Language (WSDL) Version 2.0 Part 1: Core Language, W3C, 26 June 2007, available at http://www.w3.org/TR/wsdl20 [15].

3. The WSDL file SHALL be prepared by the developer during the FPS design stage in compliance with requirements specified in sections 5.2, 5.2.1, 5.2.2, 5.2.3, and all subsections of section 7.1 of this WSRD.

NOTE: An example of a machine-processable service description document that might be produced based on the requirements provided in this section of the WSRD can be seen in an associated instructional document called How to Write a Web Service Description Document (WSDD) that describes an implemented FPS in accordance with FAA-STD-065A [3].

6   Non-Functional Requirements

6.1   Quality of Service Requirements

1. The FPS SHALL meet the required values shown for the quality of service (QoS) characteristics listed in Table 6-1.

Table 6-1 FPS Quality of Service Requirements

QoS Characteristic Name	Definition	Calculation Method	Unit of Measure	Required Value
Availability	Probability that the service is present or ready for immediate use.	100 * ((24 – Total Outage Time) / 24). Measurements are taken daily and apply to the preceding 24-hour period.	Percentage, accurate to 3 decimal places	99.900
Capacity	Number of service requests that the service can accommodate within a given time period.	Simple count.	Whole positive number, per period of time.	20 per minute
Response Time	Maximum time required to complete a service request.	Measured from the time the service provider receives the request to the time the service provider transmits the response.	Seconds.	3

6.2   Security Requirements

1. The FPS SHOULD comply with NIST Special Publication 800-95, Guide to Secure Web Services, National Institute of Standards and Technology, August 2007, available at http://csrc.nist.gov/publications/nistpubs/800-95/SP800-95.pdf [8].

2. To support transport-level security, the FPS SHALL deploy Transport Layer Security (TLS) Protocol Version 1.2, RFC 5246, Network Working Group, August 2008, available at http://tools.ietf.org/html/rfc5246 [13].

3. To support message-level security, the FPS SHALL deploy the WS-Security 1.1 family of specifications as defined in Web Services Security: SOAP Message Security 1.1 (WS-Security 2004), OASIS Standard Specification, 1 February 2006, available at http://www.oasis-open.org/committees/download.php/16790/wss-v1.1-spec-os-SOAPMessageSecurity.pdf [17].

6.2.1 Authentication

1. The FPS SHALL require each service consumer to authenticate itself to the FPS at the transport level by deploying a Username/Token credential in accordance with the Web Services Security UsernameToken Profile 1.0, OASIS Standard 200401, March 2004, available at http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-username-token-profile-1.0.pdf [16].

2. The FPS SHALL comply with Identification and Authentication requirements set forth in NIST FIPS Publication 200, Minimum Security Requirements for Federal Information and Information Systems, March 2006, available at http://csrc.nist.gov/publications/fips/fips200/FIPS-200-final-march.pdf [7].

3. Password complexity and change management SHALL be in accordance with FAA Order 1370.92A, Password and PIN Management Policy, 6 August 2010, available at http://www.faa.gov/documentLibrary/media/Order/1370.92A.pdf [2].

6.2.2 Authorization

1. The FPS SHALL use the credentials received as part of the authentication process (specified in section 6.2.1 of this WSRD) for future determinations of whether or not a service consumer is authorized to invoke an operation it may request.

2. The FPS SHALL deploy role-based access control (RBAC) for implementing authorization.

3. RBAC SHALL be implemented in accordance with ANSI/INCITS 359-2004, American National Standard for Information Technology - Role Based Access Control, Information Technology Industry Council, 3 February 2004, available at http://www.cs.purdue.edu/homes/ninghui/readings/AccessControl/ANSI+INCITS+359-2004.pdf [9].

4. The FPS SHALL define two (2) roles, "Reader" and "Originator" as described in Table 6.2 and further depicted in Figure 6-1.

Table 6-2 FPS Roles

| Name	Description
Reader	A user who only has permission to read or examine ('view only') a filed flight plan.
Originator	A user, generally a pilot or operator, who submits a flight plan and has permission to file and subsequently modify or cancel the filed flight plan. Since the Reader role is derived from the Originator role, an Originator role inherently includes the "view" privileges.
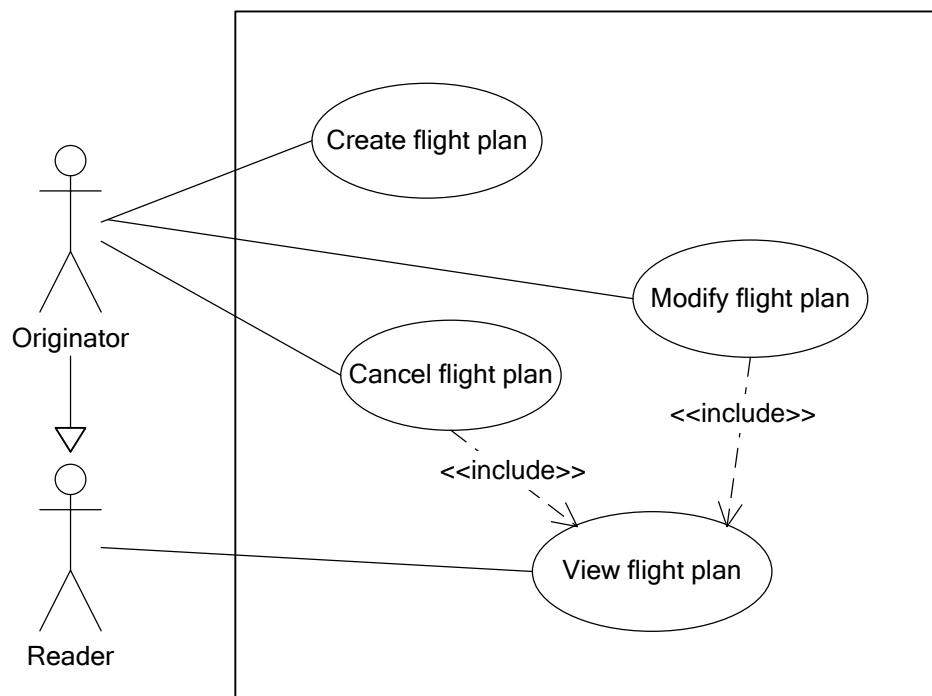
Figure 6-1 FPS Roles Use Case Diagram

6.2.3 Integrity

Because the FPS uses TLS protocol (see section 6.2 requirement 3 of this WSRD), the integrity requirements are being addressed (the data is checked for possible corruption).

6.2.4 Confidentiality

This WSRD does not impose any confidentiality requirements.

6.2.5 Non-Repudiation

1. The FPS SHALL require that each user's message be digitally signed in accordance with XML Signature Syntax and Processing (Second Edition), W3C Recommendation, 10 June 2008, available at http://www.w3.org/TR/xmldsig-core [18].

6.2.6 Audit Capability

1. The FPS SHALL require that each service request include a timestamp that indicates the date and time the request was made.

2. The FPS SHALL provide an audit trail of all service requests.

3. Each audit trail record SHALL include user ID (using credentials received as part of the authentication process), date, time, operation requested, and an error description if the operation failed.

4. Access to the audit trail SHALL be internal, i.e., inaccessible via a Web service interface.

5. Access to the audit trail SHALL be limited to users with system administrator privileges.

6.2.7 Other Security Requirements

This WSRD does not impose any other security requirements.

7 Implementation Requirements

7.1 Binding Requirements

7.1.1 Binding "SOAPoverHTTPBinding"

1. The FPS SHALL deploy the protocols described in sections 7.1.1.1 through 7.1.1.4 for the binding to the interface "FlightPlanInterface".

7.1.1.1 Data Protocol

1. For data serialization, the FPS SHALL use Extensible Markup Language (XML) 1.0 (Fifth Edition), W3C, November 2008, http://www.w3.org/TR/2008/REC-xml-20081126/ [10].

7.1.1.2 Message Protocol

1. All messages exchanged by the FPS SHALL be constructed in accordance with SOAP Version 1.2 Part 1: Messaging Framework (Second Edition), W3C Recommendation, 27 April 2007, http://www.w3.org/TR/soap12-part1/ [14].

7.1.1.3 Transport Protocol

1. The FPS SHALL use Hypertext Transport Protocol – HTTP/1.1, RFC 2616, Network Working Group, June 1999, http://www.w3.org/Protocols/rfc2616/rfc2616.html [12] as a transport-level protocol.

7.1.1.4 Other Protocols

This WSRD does not impose any other protocol requirements.

7.2 Processing Requirements

1. Any system errors (excluding those associated with fault messages) generated by the FPS SHALL be logged to aid in resolving the problem.

7.3 Operational Environment Requirements

1. The FPS SHALL be able to be used over the FAA Telecommunications Infrastructure (FTI).

2. The FPS SHALL be able to be used over the public Internet.

3. The FPS SHALL be able to use Oracle 10G as the relational database.

4. The FPS SHALL support 24-hours-a-day, 7-days-a-week operations.

5. The FPS SHALL allow continuous monitoring during operational use without disruption or any detectable degradation of normal service operations.

This WSRD does not impose any hardware compliance requirements.

8   Quality Assurance Provisions

8.1 Responsibility for Verification

The FAA is responsible for developing and implementing the verification of requirements for each project. The FAA may delegate verification activities to other organizations, independent contractors, and/or the prime contractor.

8.2 Special Verification Requirements

1. The FPS SHALL be tested in accordance with the FAA Acquisition Management System Test and Evaluation Process Guidelines, January 2011, available at http://fast.faa.gov/docs/teguidelines.doc [1].

2. The FPS SHALL be tested in its normal operating mode at the William J. Hughes Technical Center (WJHTC) System Support Computer Complex, or other appropriate demonstration site.

3. The FPS test environment SHALL include a separate testing database.

4. The FPS test environment SHALL provide a separate network address (URL) for consumer testing.

5. Problems encountered with the FPS software agent during consumer software agent testing SHOULD be reported to John D. Doe, 609-555-4444, john.d.doe@faa.gov.

8.3 Verification Requirements Traceability Matrix

Table 8-1 Verification Requirements Traceability Matrix

A = Analysis; D = Demonstration; I = Inspection; T = Test; X = Not Applicable

Section Number	Requirement Title	Req't. ID	Verification Level	
			Service Level	Integration Level
5	Functional Requirements			
5.1	Service Business Functions			
	File flight plan	1	D	D
	Change destination aerodrome	2	D	D
	Cancel flight plan	3	D	D
5.2	Service Interfaces			
	Implement FlightPlanInterface	1	D	D
5.2.1	Operations			
	Perform operation FileFlightPlan	1	D	D

Section Number	Requirement Title	Req't. ID	Verification Level	
			Service Level	Integration Level
	Perform operation UpdateDestinationAerodrome	2	D	D
	Perform operation CancelFlightPlan	3	D	D
5.2.2	Messages			
	Exchange messages as specified	1	D	D
5.2.3	Faults			
	Generate fault message as specified	1	D	D
5.2.4	Data Elements			
	Conform to FPXM 1.0	1	A, D	A, D
	Conform to specified definitions, syntax, and constraints	2	A, D	A, D
5.3	Machine-Processable Service Description Document			
	Utilize a WSDL file	1	I	X
	Comply with WSDL 2.0 specification	2	A	X
	Produce WSDL file during FPS design stage	3	I, D	X
6	Non-Functional Requirements			
6.1	Quality of Service Requirements			
	Meet required QoS values	1	D	X
6.2	Security Requirements			
	Comply with NIST 800-95	1	A, D	A, D
	Deploy TLS Protocol v1.2 (RFC 5246)	2	A, D	A, D
	Deploy WSS SOAP Message Security 1.1	3	A, D	A, D
6.2.1	Authentication			
	Deploy Username/Token credential per OASIS Standard 200401	1	A, D	A, D
	Comply with Identification and Authentication requirements in NIST FIPS publication 200	2	A, D	A, D

Section Number	Requirement Title	Req't. ID	Verification Level	
			Service Level	Integration Level
	Comply with FAA Order 1370.92A	3	A, D	A, D
6.2.2	Authorization			
	Utilize authentication credential to authorize service operations	1	A, D	A, D
	Deploy role-based access control (RBAC)	2	D	D
	Comply with ANSI/INCITS 359-2004	3	A, D	A, D
	Define 2 roles, "Reader" and "Originator"	4	D	X
6.2.3	Integrity			
6.2.4	Confidentiality			
6.2.5	Non-Repudiation			
	Require digital signatures per W3C Recommendation 10 June 2008	1	D	D
6.2.6	Audit Capability			
	Include timestamp on each request	1	D	X
	Provide an audit trail	2	D	X
	Provide specified audit trail data elements	3	D	X
	Audit trail access is internal	4	D	X
	Limit access to system administrator	5	D	X
6.2.7	Other Security Requirements			
7	Implementation Requirements			
7.1	Binding Requirements			
7.1.1	Binding "SOAPOverHTTPBinding"			
	Implement SOAPoverHTTPBinding	1	A, D	A, D
7.1.1.1	Data Protocol			
	Utilize XML 1.0 for data serialization	1	A, D	A, D
7.1.1.2	Message Protocol			

Section Number	Requirement Title	Req't. ID	Verification Level	
			Service Level	Integration Level
	Construct messages per W3C SOAP V1.2 Part 1	1	A, D	A, D
7.1.1.3	Transport Protocol			
	Utilize HTTP 1.1 (RFC 2616)	1	A, D	A, D
7.1.1.4	Other Protocols			
7.2	Processing Requirements			
	Log all system errors generated by FPS	1	D	X
7.3	Operational Environment Requirements			
	Utilize FTI	1	D	D
	Utilize public Internet	2	D	D
	Utilize Oracle 10G as relational database	3	I, D	X
	Support operations 24/7	4	A	X
	Allow continuous monitoring	5	A, D	X
8	Quality Assurance Provisions			
8.1	Responsibility for Verification			
8.2	Special Verification Requirements			
	Conduct testing in accordance with FAA Acquisition Management System Test and Evaluation Process Guidelines	1	A, D	A, D
	Conduct testing at WJHTC	2	X	X
	Include separate testing database	3	I, D	X
	Provide separate URL for consumer testing	4	D	X
	Provide FPS problem reporting point of contact	5	X	X

9 Appendixes

Appendix A. FlightPlan.xsd

```xml
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
 xmlns="urn:us:gov:dot:faa:example:atm:enroute:fps:entities"
targetNamespace="urn:us:gov:dot:faa:example:atm:enroute:fps:entities"
elementFormDefault="qualified" attributeFormDefault="unqualified">
  <xs:annotation>
    <xs:documentation xml:lang="en">
      Title: FlightPlan schema for WSRD Example.
     Description: This schema declares XML elements for defining
     a Flight Plan transmitted by FlightPlanService
     Creator: Mark Kaplun (mark.kaplun@faa.gov)
     Date:  2010-01-21
     See also: WSRD Flight Plan Service.doc
     </xs:documentation>
  </xs:annotation>
  <!--
/////////////////////////////////////////////////////////////////
                  Global types

///////////////////////////////////////////////////////////////// -->
  <xs:element name="FlightPlan">
    <xs:complexType>
      <xs:sequence>
        <!-- "FlightPlanId" is always required.
             When flight plan is filed and the "FlightPlanId" element
has no content
             - the content is nil. -->
        <xs:element name="FlightPlanId" type="FlightPlanIdType"
nillable="true"/>
        <xs:element name="Originator" type="OriginatorType"/>
        <xs:element ref="Aircraft"/>
        <xs:element ref="Route"/>
      </xs:sequence>
      <xs:attribute name="filingTime" type="xs:dateTime"
use="required"/>
      <xs:attribute name="flightRule" type="FlightRuleType"
use="required"/>
      <xs:attribute name="numberOfAircraft" type="xs:positiveInteger"
default="1"/>
    </xs:complexType>
  </xs:element>
  <xs:element name="Aircraft" type="AircraftType"/>
  <xs:element name="Route" type="RouteType"/>
  <!--
/////////////////////////////////////////////////////////////////
                  Types definitions
   ///////////////////////////////////////////////////////////////// -
->
  <xs:simpleType name="FlightPlanIdType">
    <xs:restriction base="xs:string">
```

```
        <xs:pattern value="[A-Za-z0-9]*"/>
      </xs:restriction>
    </xs:simpleType>
    <xs:complexType name="AircraftType">
      <xs:sequence>
        <xs:element name="Equipage">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="Communication" type="xs:string"/>
              <xs:element name="Navigation" type="xs:string"/>
              <xs:element name="Surveillance" type="xs:string"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
        <xs:element name="WakeTurbulenceCategory"
type="WakeTurbulenceCategoryType"/>
      </xs:sequence>
      <xs:attribute name="aircraftId" type="xs:string"/>
      <xs:attribute name="aircraftType" type="xs:string"/>
      <!-- Values are listed in ICAO 8643, Aircraft Type Designators,
              http://www.icao.int/anb/ais/8643/index.cfm.-->
    </xs:complexType>
    <xs:complexType name="OriginatorType">
      <xs:sequence>
        <xs:element name="Name" type="xs:string"/>
      </xs:sequence>
      <xs:attribute name="airmanId" type="xs:string" use="required"/>
    </xs:complexType>
    <xs:complexType name="RouteType">
      <xs:sequence>
        <xs:element name="Altitude" type="AltitudeType"/>
        <xs:element name="EstimatedTime ">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="EstimatedDepartureTime" type="xs:time"/>
              <xs:element name="EstimatedEnRouteTime"
type="xs:duration"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
        <xs:element name="AirSpeed" type="AirSpeedType"/>
        <xs:element name="DepartureAerodrome" type="AerodromeType"/>
        <xs:element name="DestinationAerodrome" type="AerodromeType"/>
        <xs:element name="AlternateAerodrome" type="AerodromeType"/>
        <xs:any minOccurs="0" maxOccurs="unbounded">
          <!--This element is declared as "any" to indicate that Route
element
              can be extended with elements such as: fixes (significant
points),
              route names, route segments and etc. -->
        </xs:any>
      </xs:sequence>
    </xs:complexType>
    <xs:complexType name="AerodromeType">
      <xs:annotation>
```

```
        <xs:documentation>
          Values for aerodrome Ids are listed in ICAO Document 7910,
          Location  Indicators, http://www.icao.int/eshop/index.html.
        </xs:documentation>
      </xs:annotation>
      <xs:sequence>
        <xs:element name="Name" type="xs:string"/>
      </xs:sequence>
      <xs:attribute name="aerodromeId" type="AerodromeIdType"
use="required"/>
  </xs:complexType>
  <xs:simpleType name="SpeedBase">
      <xs:restriction base="xs:decimal"/>
  </xs:simpleType>
  <xs:complexType name="TrueSpeedType">
      <xs:simpleContent>
        <xs:extension base="SpeedBase">
          <xs:attribute name="uom" type="UnitOfSpeedType"
default="knots"/>
        </xs:extension>
      </xs:simpleContent>
  </xs:complexType>
  <xs:complexType name="AirSpeedType">
      <xs:sequence>
        <xs:element name="TrueSpeed" type="TrueSpeedType"/>
        <xs:element name="MachNumber" type="xs:decimal"/>
      </xs:sequence>
  </xs:complexType>
  <xs:simpleType name="AltitudeBase">
      <xs:restriction base="xs:nonNegativeInteger"/>
  </xs:simpleType>
  <xs:complexType name="AltitudeType">
      <xs:simpleContent>
        <xs:extension base="AltitudeBase">
          <xs:attribute name="uom" type="UnitOfAltitudeType"
default="foot"/>
          <xs:attribute name="referenceDatum" type="ReferenceDatumType"
use="required"/>
        </xs:extension>
      </xs:simpleContent>
  </xs:complexType>
  <!--
//////////////////////////////////////////////////////////////
                Code types
    //////////////////////////////////////////////////////////////
-->
  <xs:simpleType name="AerodromeIdType">
    <xs:restriction base="xs:string">
      <xs:maxLength value="4"/>
      <xs:pattern value="[A-Z][A-Z][A-Z][A-Z]"/>
    </xs:restriction>
  </xs:simpleType>
  <!--
//////////////////////////////////////////////////////////////
                Enumerations types
```

```
    //////////////////////////////////////////////////////////////
-->
  <xs:simpleType name="FlightRuleType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="I"/>
      <xs:enumeration value="V"/>
      <xs:enumeration value="Y"/>
      <xs:enumeration value="Z"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="WakeTurbulenceCategoryType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="H"/>
      <xs:enumeration value="HEAVY"/>
      <xs:enumeration value="M"/>
      <xs:enumeration value="MEDIUM"/>
      <xs:enumeration value="L"/>
      <xs:enumeration value="LIGHT"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="ReferenceDatumType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="local"/>
      <xs:enumeration value="standard"/>
    </xs:restriction>
  </xs:simpleType>
  <!--
//////////////////////////////////////////////////////////////////
                  Units of Measurement  enumerations

//////////////////////////////////////////////////////////////////
-->
  <xs:simpleType name="UnitOfSpeedType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="km/h"/>
      <xs:enumeration value="knots"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:simpleType name="UnitOfAltitudeType">
    <xs:restriction base="xs:string">
      <xs:enumeration value="m"/>
      <xs:enumeration value="meter"/>
      <xs:enumeration value="foot"/>
    </xs:restriction>
  </xs:simpleType>
</xs:schema>
```
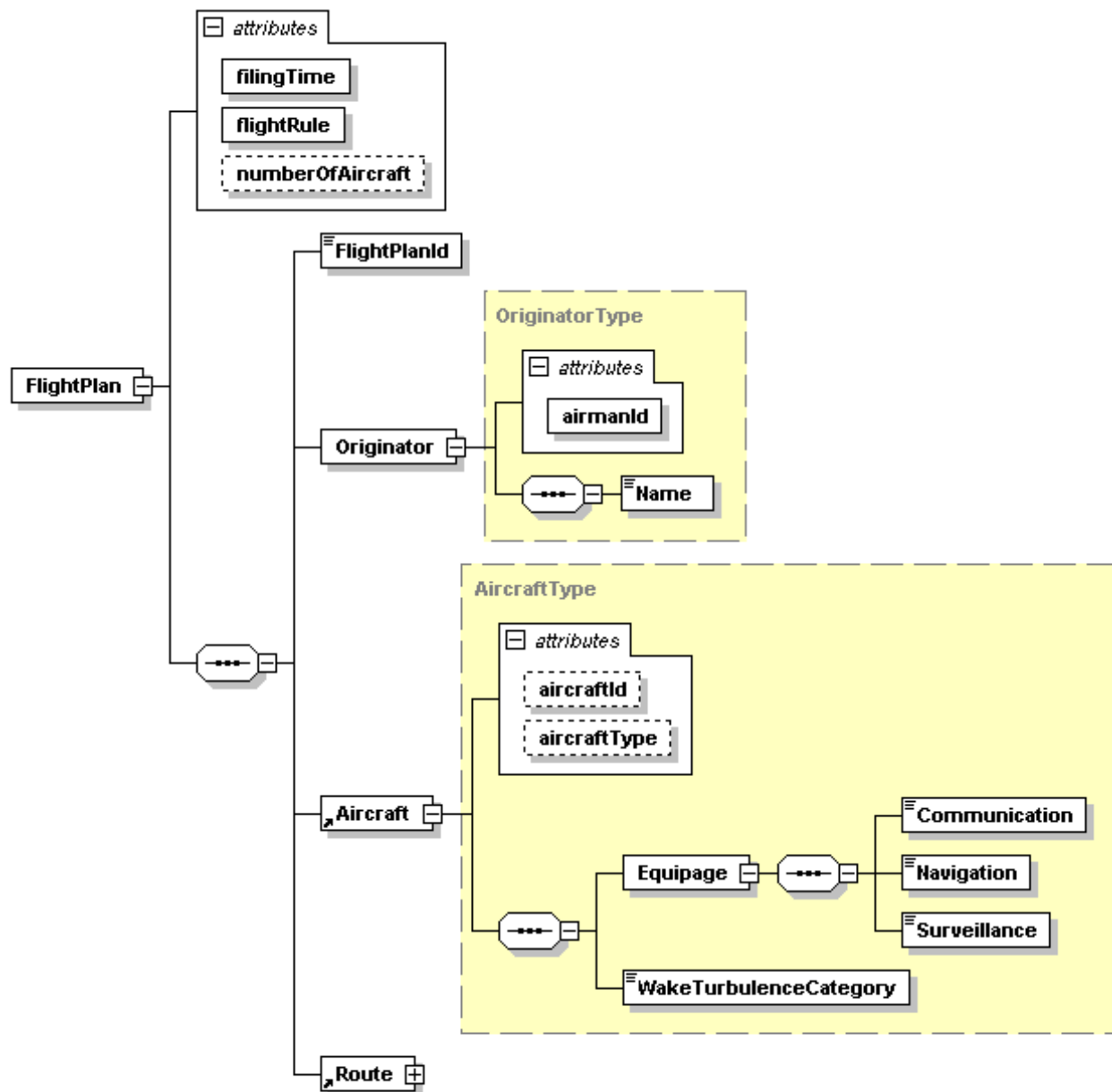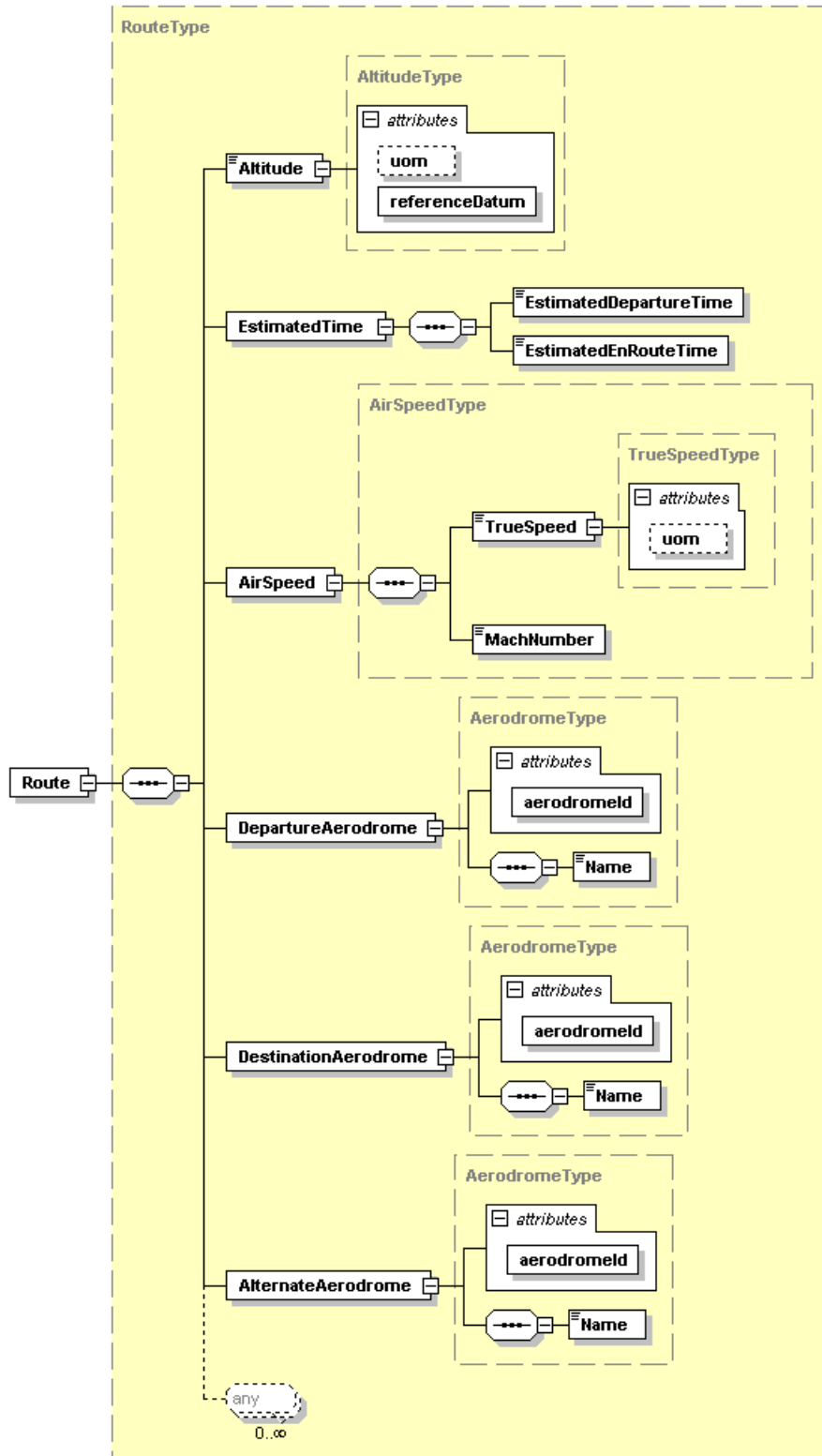
Appendix B. FlightPlan.xsd – diagram

Fragment - Route element

Appendix C. FlightPlan.xml

```xml
<?xml version="1.0" encoding="UTF-8"?>
<FlightPlan
xmlns="urn:us:gov:dot:faa:example:atm:enroute:fps:entities"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="./FlightPlan.xsd"
   flightRule="I"
   numberOfAircraft="1"
   filingTime="2001-12-17T09:30:47Z" >
     <FlightPlanId xsi:nil="true" />
     <Originator airmanId="215336745">
          <Name>John Doe</Name>
     </Originator>
     <Aircraft aircraftType="PA-32R" aircraftId="JHB426E">
          <Equipage>
               <Communication>V</Communication>
               <Navigation>C</Navigation>
               <Surveillance>OL</Surveillance>
          </Equipage>
          <WakeTurbulenceCategory>LIGHT</WakeTurbulenceCategory>
     </Aircraft>
     <Route>
          <Altitude referenceDatum="local" uom="foot">7000</Altitude>
          <EstimatedTime>

     <EstimatedDepartureTime>14:20:00.0Z</EstimatedDepartureTime>
               <EstimatedEnRouteTime>PT3H30M</EstimatedEnRouteTime>
          </EstimatedTime>
          <AirSpeed>
               <TrueSpeed uom="knots">170</TrueSpeed>
               <MachNumber>0.12</MachNumber>
          </AirSpeed>
          <DepartureAerodrome aerodromeId="KBWI">
               <Name>Baltimore-Washington International, MD</Name>
          </DepartureAerodrome>
          <DestinationAerodrome aerodromeId="KBOS">
               <Name>Logan International Airport,Boston, MA</Name>
          </DestinationAerodrome>
          <AlternateAerodrome aerodromeId="KJFK">
               <Name>John F. Kennedy International
Airport,NY,NY</Name>
          </AlternateAerodrome>
     </Route>
</FlightPlan>
```